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NOTES ON THE SCALES OF FISHES. THE HERBIVOROUS CYPRINIDÆ.

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It has been remarked by Jordan and Evermann (Fishes of North and Middle America, p. 202) that the subfamily *Chondrostominae*, as recognized in America, is extremely heterogeneous. A study of the scales of most of the genera clearly indicates that the group is even less uniform than has been supposed, and makes it practically certain that it should be divided into three subfamilies, which are not especially related. *Chrosomus* stands entirely apart in the structure of its scales, which resemble in sculpture those of Catostomidæ. The Catostomids are evidently an ancient, and in some respects, primitive group, which probably inhabited North America before there were any true Cyprinidæ on this continent. *Chrosomus* may not be supposed to have been derived from the Catostomids, but must apparently be regarded as an ancient offshoot from the stem which gave rise to Cyprinidæ and Catostomidæ alike.

Contrasting with *Chrosomus* in nearly every way, but related to it in the small scales and the traces of basal radii, is the Chondrostomine group proper, including fishes of the Pacific coast region, closely related to those of the Old World.* These must be regarded as comparatively recent (Miocene?) immigrants, which have never crossed the Rocky Mountains. The third series typified by *Pimephales*, consists of large-scaled fishes with no traces of basal radii. They are entirely different from the two small-scaled groups, and must have had a quite distinct

* Basal radii are common in Old World Cyprinidæ, but exist in very few North America genera. *Rhinichthys* and *Agosia* have them, but they are absent in the great mass of the carnivorous forms.

origin. In their scaling, however, they show a distinct approximation to the otherwise aberrant *Campostominae*, and it is probably safe to say that they are much nearer *Campostoma* than are any of the other herbivorous genera.

Depending principally on scale characters, the four subfamilies of herbivorous Cyprinids may be separated as follows:

SUBFAMILIES OF NORTH AMERICA HERBIVOROUS CYPRINIDÆ.

Scales small, with small radii all around; breadth usually greater than length, the scales transversely suboval. Small fishes of the Eastern United States, with two dark bands on each side, the upper sometimes faint.

CHROSOMINÆ (*Chrosomus* Raf.).

Scales small, with strong but not very numerous apical radii, basal radii evanescent but usually more or less indicated. Silvery fishes of the Pacific coast region without evident dark band.

CHRONDROSTOMINÆ (*Acrocheilus* Agass., *Orthodon* Girard).

Scales large and broad, apical radii numerous, no trace of basal radii.

Nuclear area large and very broad, the radii subparallel.

CAMPOSTOMINÆ (*Campostoma* Agass.).*

Nuclear area small, the radii converging; fishes of small or moderate size with one dark lateral band.

PIMEPHALINÆ (*Pimephales* Raf., *Hybognathus* Agass.).

Hybognathus is remarkable for the very thick skin covering the scales; in *Pimephales* the skin is thin, and the radii are clearly visible. The gill-lamellæ, judging from our material, appear to present diagnostic characters. In *Orthodon* and *Acrocheilus* they are disposed in a very regular manner, fitting closely together. In *Hybognathus nuchalis* they are regular, and scarcely fimbriate, but in *Pimephales anuli* they are strongly fimbriate. In *P. anuli* they are obtuse apically; in *P. notatus* tapering. In *Chrosomus dakotensis* they are stout, in *C. erythrogaster* slender. Possibly these characters would not hold good in a long series

* The pharyngeal teeth of *Campostoma* are more or less hooked and really very like those of *Leuciscus*, etc. The relationship of the Campostominae and Pimephalinae to the Leuciscine series is a matter to be further investigated.

of the fishes. In any event, they seem to be of specific rather than generic or subfamily importance. The fishes upon which this study is based were with two exceptions kindly sent to us by the U. S. Bureau of Fisheries and Stanford University. For the Old World (River Nile) species we are indebted to the Government of Egypt, through the British Museum. We are indebted to Doctors David Starr Jordan and Barton Warren Evermann for very kindly going over our manuscript.